DR-36. STRUCTURAL FEATURES AND ANTIMICROBIAL ACTIVITY OF SILICON-ZINC-BORON-CONTAINING GLYCEROHYDROGEL

V. V. Permikin[1], E. Yu. Nikitina[1], M. V. Ivanenko[1], A. S. Barkova[2], T. G. Khonina[1,2]

[1] I. Ya. Postovsky Institute of Organic Synthesis UB RAS,
S. Kovalevskoy/Akademicheskaya St., 20/22, Yekaterinburg, 620990, Russia

[2] Ural State Agrarian University, Karla Libknekhta St., 42, Yekaterinburg, 620075, Russia

E-mail: vasiliy_permikin@mail.ru

We have synthesized novel pharmacologically active silicon-zinc-boron-containing hydrogel (Si-Zn-B-gel) [1] by a «one-pot» green sol-gel synthesis using silicon, zinc, and boron glycerolates as precursors. The *in vivo* tests have shown that Si-Zn-B-gel is non-toxic. Preliminary trials have showed that the gel possesses the wide range of pharmacological activity, in particular, antimicrobial. However, comparative studies in this area were not conducted. In addition, the mechanism of formation and the structure of Si-Zn-B-gel were investigated insufficiently. Thus, the objective of the present work was to study the structural features of Si-Zn-B-gel and its antimicrobial activity in comparative aspect.

It was shown, that the gel 3D-network is formed by the products of hydrolysis and subsequent (co)condensation of silicon- and boron (not zinc)-containing precursors. The main part of zinc monoglycerolate does not undergo the hydrolytic transformations under gelation conditions and exists in the cells of the 3D-polymeric network in the form of amorphous nanoscale particles. Zinc monoglycerolate is not linked to the network by covalent bonds and it forms a separate phase. The dispersion medium of the gel is an aqueous-glycerol solution of silicon and boron glycerolates and the products of their hydrolytic transformations, including the water-soluble products of hydrolytic transformations of zinc monoglycerolate.

The antimicrobial (antibacterial and antimycotic) activity of the hydrogel was investigated by agar well-diffusion method according to CLSI (Clinical and Laboratory Standards Institute) guidelines. 3 % Tetracycline Ointment (positive control against bacteria strains) and 1 % Exoderil Solution (positive control against *C. albicans*). Vaseline Ointment was used as negative control in all the cases.

It was established, that Si-Zn-B-gel exhibits high bactericidal activity *in vitro* against the most frequent pathogens *E. coli, S. aureus*, including strains of *S. aureus*, which demonstrate methicillin resistance (MRSA), and *S. pyogenes*, then control samples. We consider that the biological activity of silicon-zinc-boron-containing glycerohydrogel is provided by silicon and boron glycerolates and products of their hydrolytic transformations, including the hydrolytic transformation products of zinc monoglycerolate in an aqueous-glycerol dispersion medium, and also by amorphous nanoscale particles of zinc monoglycerolate in the cells of the hydrogel 3D-network.

The gel can be considered as a promising antimicrobial agent, prepared in a simple and cost-effective manner. It may be suitable for formation of new types of bactericidal topical drugs.

References

1. Патент № 2623153 Российская Федерация. Кремнийцинкборсодержащий глицерогидрогель для местного применения, обладающий ранозаживляющей, регенерирующей, бактерицидной и противогрибковой активностью / Чарушин В. Н., Кунгуров Н. В., Чупахин О. Н., Хонина Т. Г., Евстигнеева Н. П., Кохан М. М., Зильберберг Н. В., Ларионов Л. П., Аминева П. Г., Шадрина Е. В., Иваненко М. В., Зырянова И. Г., Полищук А. И., Кузнецов И. Д. № 20151503/68; заявл. 24.11.2015; опубл. 22.06.2017. 2 с.

2. Synthesis and properties of biologically active silicon, zinc-glycerohydrogel / O. N. Chupakhin [et al.] // Russ. Chem. Bull. Springer US, 2014. Vol. 63, № 5. P. 1219.

3. Silicon-zinc-glycerol hydrogel, a potential immunotropic agent for topical application / T. G. Khonina [et al.] // Eur. J. Pharm. Sci. Elsevier, 2017. Vol. 107. P. 197.

This work was carried out within the framework of the project of UB RAS Integrated Program (theme № AAAA-A18-118020290163-9).